to some agent which had produced a photographic effect; although the sensitive plate was completely in the dark within the printing frame and thoroughly protected from light rays as generally understood. Apparently, however, the plate had been over-exposed, and it seemed that better results might be obtained by shorter exposures. Therefore other plates of the same kind were exposed by us for gradually decreasing periods, under negatives and positives, and shields, respectively of aluminium, hard rubber, black cardboard and double thicknesses of opaque needle paper.

Positives were obtained in each case resembling those obtained by the photographer with ordinary methods, in some cases the exposures being as brief as ten minutes.

Shadowgraphs ('skotographs,' or 'skiagraphs') were also produced by the method employed by Prof. Röntgen, except that the source of energy was the direct sunlight in place of the rays from a vacuum tube, *i. e.*, coins placed upon the aluminium shield produced shadow prints on the sensitive plate.

It is obvious that these experiments prove the presence in sunlight of the peculiar rays described by Prof. Röntgen, or of others possessing the same properties, namely, the power of penetrating substances opaque to ordinary light rays.

Prof. Röntgen states, in the second clause of his article (as translated and printed in SCIENCE of February 14th, p. 227,) 'that some agent is capable of penetrating black cardboard, which is quite opaque to ultra-violet light, sunlight or arc-light.' If this statement refers to sunlight *in toto*, including the visible and invisible rays, it is evidently contravened by our experiments, which demonstrate beyond a doubt the existence of an 'agent' in sunlight, which accomplishes the work of the 'X-rays.'

Prof. Röntgen refers to the possibility that the effect is due to a fluorescence produced in the material of the sensitive plate. One of our experiments seemed to point to the correctness of this hypothesis. Fixed photographic prints on albumin paper placed between the aluminium shield and the sensitive plate gave corresponding negative effects; but the space covered by these prints was evidently more intensely acted upon by the rays than other parts of the plate covered only by the aluminium. Should fluorescence be produced by these rays in silver emulsions, it would perhaps explain the phenomena. Prof. Röntgen further states that silver in 'thin' layers allows the rays to pass; but we have shown that some of the rays are partially stopped by the exceedingly thin film of silver in the ordinary photographic negative.

It is obvious that the discovery of these rays in sunlight opens up an entirely new field for experiment and is of the highest practical importance to all photographers.

We hope to supplement this preliminary statement by a presentation of the results of our attempts to solve a number of interesting problems that have been suggested.

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[Results somewhat similar to those given by Drs. Dolley and Egbert have been announced by M. Gustav Le Bon, Prof. S. P. Thompson and others. The conditions, are, however, so complex that it is difficult to eliminate sources of energy other than the Röntgen rays. Careful experiments at Columbia College have not detected any penetration of thin ($\frac{1}{100}$ inch) sheets of aluminium by sunlight, though ebonite and wood of considerable thickness are penetrated by ordinary light. Ed].

RÖNTGEN RAYS FROM THE ELECTRIC ARC.

PROF. S. P. THOMPSON is reported * to have discovered the Röntgen rays in the radiations emitted by the electric arc, and to have succeeded in getting excellent shadow pictures with them. The present writer had carried out the following experiments before seeing the report of S. P. Thompson's work, and had reached conclusions opposite to those reported of Prof. Thompson.

Very rapid (Carbutt's 'Eclipse 27') and medium (Carbutt's 'Orthochromatic 23') plates, placed in ordinary holders, were laid in deep lead trays and masked with two to five thicknesses of black cardboard, including the card-

* London, *Electrician*, January 24, 1896. Digest in the *Electrical World* February 15th.

board slide of the plateholder. Bits of sheet aluminum (¼ mm. thick) and of sheet lead (¾ mm. thick) were laid upon the cardboard slide of the plateholder. Two to five hours' exposure to a 900 Watt arc at a distance of 25 cm. produced no perceptible effect.

The bits of sheet metal were then for convenience placed next to the gelatine film and the plates, masked with two thickness of black cardboard, were exposed to the arc for three hours at a distance of about 12cm. The plates become quite hot, about 80°C. after development the action was found to be quite strong where the plate was not screened by the bits of metal. The bits of metal, each several square centimeters in area, screened the plates about equally. The portions of the films under the bits of metal showed very faintly the texture of metal surface, as if by reflection.

The plates were then arranged so as to obviate excessive heating by ventilation, and masked with two thicknesses of black cardboard and two to four thicknesses of mask paper, the bits of sheet metal being placed outside the cardboard slide of the plate holder as at first. Three hours' exposure at a distance of 15 cm. from the arc produced no perceptible effect.

The arc was then arranged to play between zinc and carbon, taking about ten amperes at thirty-five volts. The plates arranged as described in the previous paragraph were exposed to this zinc arc for two hours at a distance of about ten centimeters. The zinc rod was cathode for about one hour and anode for about one hour. No perceptible effect was produced.

It seems justifiable to conclude from these experiments that Röntgen rays are not given off in any abundance by the electric arc, and that they are not of the same nature as the ultra-violet of the spectrum, or at least that they are not of the same nature as the ultra-violet, which is present in any abundance in the light emitted by the electric arc between carbon electrodes or between zinc electrodes.

In demonstrating the presence of Röntgen rays it is necessary in every case to exercise the greatest care in the rigid exclusion of every other agent capable of affecting the sensitive plate, such as ordinary and ultra-violet light, electric charge acting directly upon the film, mechanical pressure, high temperature, etc. These rays and the cathode rays are distinguished among all other actinic radiations by the facility with which they pass through metals and from each other by their different behavior in the magnetic field, as appears from Röntgen's paper.

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SCIENTIFIC LITERATURE.

Grundzüge der Marinen Tiergeographie. Anleitung zur Untersuchung der geographischen Verbreitung Mariner Tiere mit besonderer Berücksichtigung der Dekapodenkrebse. Von DR. ARNOLD E. ORTMANN, in Princeton, N. J., U. S. A. Mit 1 Karte. Jena, Verlag von Gustav Fischer. 1896. Pp. 96. M. 2.50.

This is an excellent contribution to zoögeography, which ought to be in the hands of everybody interested in the fascinating questions of animal distribution. A great number of highly interesting points are also discussed, important for the biologist and geologist.

The principal aim of this work, the author states in the introduction, is to call the attention of the scientific world to the highly interesting study of the distribution of marine animals hitherto greatly neglected. Before all, the principles had to be established, according to which the distribution of marine animals has to be examined; in doing so it was necessary to discuss the general principles of animal distribution. Since the question of the distribution of species is most intimately connected with that of their origin the latter had to be examined, and the result is reached that the principle of separation or isolation is one of the most important factors. As an example of distribution Dr. Ortmann selected the group of decapod crustaceans, of which he has made special studies. He finishes his introductory remarks with the very pertinent sentence that without extensive and critical systematic preliminary work fruitful geographical studies are absolutely impossible.

The work is divided into seven chapters. The first chapter gives an historical review of the development of zoögeographical science. He distinguishes three periods.